Rocky Mountain Research Station

April–June 2007

# New Publications

## Contents



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http://www.fs.fed.us/rm/publications

## Check Out Our New Science Research Programs

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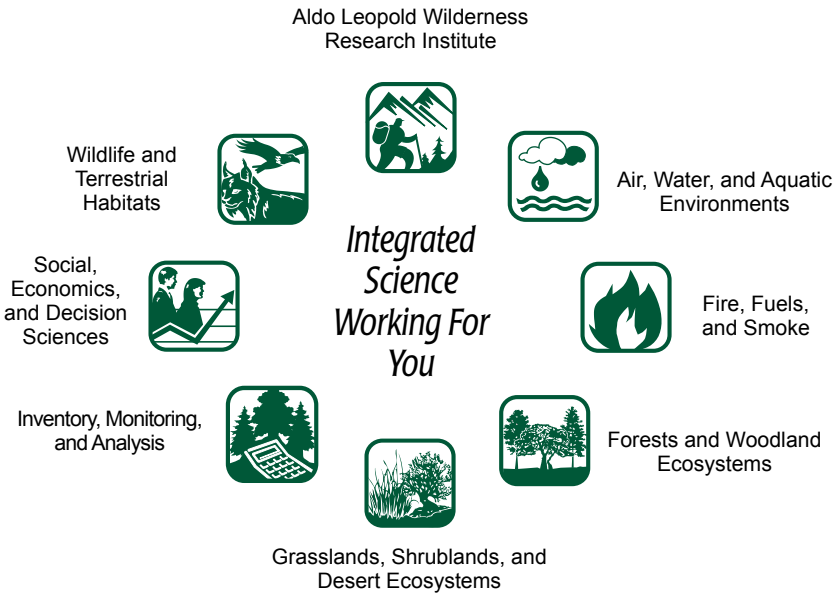
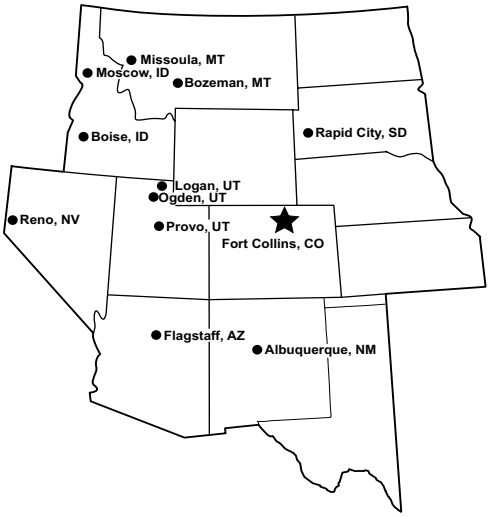
The Rocky Mountain Research Station (RMRS) is evolving from a Station with 30 research work units (including ecosystem management units and national programs) to a comprehensive programmatic structure consisting of eight Science Program areas (detailed inside) and several Research, Development and Applications programs. New research publications, including journal articles and other source articles, are listed for your review. Series publications are marked with program icons below.




New innovative science programs direct us on our path toward excellence in developing and delivering scientific knowledge and technology to sustain our forests, rangelands, and grasslands.

# The Rocky Mountain Research Station




The Rocky Mountain Research Station is one of five regional units that make up the USDA Forest Service Research and Development organization—the most extensive natural resources research organization in the world. We maintain 14 research locations throughout a 14-state territory encompassing the Great Basin, Southwest, Rocky Mountains and parts of the Great Plains. The Station employs over 400 permanent full-time employees, including more than 100 research scientists

Scientists conduct research that spans an area containing 52% of the nation's National Forest System lands (54 National Forests and Grasslands). In the lower 48 states, our territory also includes 55% of the nation's BLM lands; 48% of the designated wildernesses; 37% of National Park Service lands; numerous other public and tribal lands; and 41% of the non-urban/rural private lands.

We administer and conduct research on 14 experimental forests, ranges and watersheds while maintaining long-term databases for these areas. We also oversee activities on more than 260 Research Natural Areas and lead ecosystem management and research partnership projects in Arizona, Montana, New Mexico and Nevada.

For more information, please visit us on the Web at:
http://www.fs.fed.us/rmrs/

USDA

# New RMRS Series Publications

## National Fire Plan

**Order 5**

**Research Areas:**

**Accomplishing and applying National Fire Plan research and development from 2001–2005**. Baldwin, V. Clark, Jr., ed. 2007. Gen. Tech. Rep.RMRS-GTR-187. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 46 p.

This report highlights selected accomplishments achieved by USDA Forest Service National Fire Plan Research and Development projects from 2001 through 2005. The projects highlighted here are examples of the broad range of knowledge and tools developed by the National Fire Plan Research and Development, beginning in 2001.

Online: http://www.fs.fed.us/rm/pubs/rmrs_gtr187.html

## ERMiT user manual

**Order 6**

**Research Areas:**

**Erosion Risk Management Tool (ERMiT) user manual (version 2006.01.18)**. Robichaud, Peter R.; Elliot, William J.; Pierson, Fredrick B.; Hall, David E.; Moffett, Corey A.; Ashmun, Louise E. 2007. Gen. Tech. Rep. RMRS-GTR-188. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 24 p.

This user manual describes the input parameters, input interface, model processing, and output files for version 2006.01.18. ERMiT is a web-based application that uses Water Erosion Prediction Project (WEPP) technology to estimate erosion, in probabilistic terms, on burned and recovering forest, range, and chaparral lands with and without the application of erosion mitigation treatments. User inputs are processed by ERMiT to combine rain event variability with spatial and temporal variabilities of soil burn severity and soil properties, which are then used as WEPP input parameters. Based on 20 to 40 individual WEPP runs, ERMiT produces a distribution of rain event sediment delivery rates with a probability of occurrence for each of five postfire years.

Online: http://www.fs.fed.us/rm/pubs/rmrs_gtr188.html

## Piecewise regression

**Order 7**

**Research Areas:**

**A tutorial on the piecewise regression approach applied to bedload transport data**. Ryan, Sandra E.; Porth, Laurie S. 2007. Gen. Tech. Rep. RMRS-GTR-189. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 41 p.

This tutorial demonstrates the application of piecewise regression to bedload data to define a shift in phase of transport so that the reader may perform similar analyses on available data. First, the statistical theory behind piecewise regression analysis and its procedural approaches are presented. The reader is then guided through an example procedure and the code for generating an analysis in SAS is outlined. The results from piecewise regression analysis from a number of additional bedload datasets are presented to help the reader understand the range of estimated values and confidence limits on the breakpoint that the analysis provides. The identification and resolution of problems encountered in bedload datasets are also discussed. Finally, recommendations on a minimal number of samples required for the analysis are proposed.

Online: http://www.fs.fed.us/rm/pubs/rmrs_gtr189.html

## Photoload sampling

**Order 8**

**Research Areas:**

**The photoload sampling technique: estimating surface fuel loadings from downward-looking photographs of synthetic fuelbeds**. Keane, Robert E.; Dickinson, Laura J. 2007. Gen. Tech. Rep. RMRS-GTR-190. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 44 p.

This report presents a new fuel sampling method, called the photoload sampling technique, to quickly and accurately estimate loadings for six common surface fuel components (1 hr, 10 hr, 100 hr, and 1000 hr downed dead woody, shrub, and herbaceous fuels). This report contains a set of photoload sequences that describe the range of fuel component loadings for common forest conditions in the northern Rocky Mountains of Montana, U.S.A. to estimate fuel loading in the field. A companion publication (RMRS-RP-61CD) details the methods used to create the photoload sequences and presents a comprehensive evaluation of the technique.

Online: http://www.fs.fed.us/rm/pubs/rmrs_gtr190.htm

## Photoload sampling technique

**Order 9**

**Research Areas:**

**Development and evaluation of the photoload sampling technique**. Keane, Robert E.; Dickinson, Laura J. 2007. Res. Pap. RMRS-RP-61CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 29 p. One CD

This report presents the development and evaluation of a new fuel sampling method, called the photoload sampling technique, to quickly and accurately estimate loadings for six common surface fuel components using downward-looking and oblique photographs depicting a sequence of graduated fuel loadings of synthetic fuelbeds. This report details the methods used to construct the photoload sequences (series of photos depicting gradually increasing loadings) for the six fuel components. A companion paper (RMRS-GTR-190) presents the set of photoload sequences developed from this study for common fuelbed conditions found in the northern Rocky Mountains of Montana, USA, along with a detailed sampling protocol that can be used with these photoload picture series to estimate fuel component loadings in the field at various levels of effort and scale.

Online: http://www.fs.fed.us/rm/pubs/rmrs_rp061.html

## Bedload traps guidelines

**Order 10**

**Research Area:**

**Guidelines for using bedload traps in coarse-bedded mountain streams: Construction, installation, operation, and sample processing**. Bunte, Kristin; Swingle, Kurt W.; Abt, Steven R. 2007. Gen. Tech. Rep. RMRS-GTR-191. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 91 p.

A bedload trap is a portable sampler designed specifically for collecting gravel and cobble bedload (4 to 180 mm in diameter) in wadeable streams. In this document, we provide detailed guidelines for bedload trap construction and operation. We describe component parts and offer instructions for making the nets and assembling the sampler. Appropriate site selection and preparation are discussed as well as bedload trap installation, use, and maintenance. These guidelines also show how to process the collected bedload samples in the field and how to perform some of the typical calculations used in bedload evaluation.

Online: http://www.fs.fed.us/rm/pubs/rmrs_gtr191.html



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## Fire behavior nomographs

**Order 11**

**Research Areas:**

**Nomographs for estimating surface fire behavior characteristics**. Scott, Joe H. 2007. Gen. Tech. Rep. RMRS-GTR-192. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 119 p.

A complete set of nomographs for estimating surface fire rate of spread and flame length for the original 13 and new 40 fire behavior fuel models is presented. The nomographs allow calculation of spread rate and flame length for wind in any direction with respect to slope and allow for nonheading spread directions. Basic instructions for use are included.

Online: http://www.fs.fed.us/rm/pubs/rmrs_gtr192.html

## Landscape modeling

**Order 12**

**Research Areas:**

**Research agenda for integrated landscape modeling**. Cushman, Samuel A.; McKenzie, Donald; Peterson, David L.; Littell, Jeremy; McKelvey, Kevin S. 2007. Gen. Tech. Rep. RMRS-GTR-194. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 51 p.

Reliable predictions of how changing climate and disturbance regimes will affect forest ecosystems are crucial for effective forest management. Current fire and climate research in forest ecosystem and community ecology offers data and methods that can inform such predictions. We discuss the strengths and weaknesses of three modeling paradigms: empirical gradient models, mechanistic ecosystem models, and stochastic landscape disturbance models. We then propose a synthetic approach to multi-scale analysis of the effects of climatic change and disturbance on forest ecosystems. Empirical gradient models provide an anchor and spatial template for stand-level forest ecosystem models by quantifying key parameters for individual species and accounting for broad-scale geographic variation among them. Gradient imputation transfers predictions of fine-scale forest composition and structure across geographic space. Mechanistic ecosystem dynamic models predict the responses of biological variables to specific environmental drivers and facilitate understanding of temporal dynamics and disequilibrium. Stochastic landscape dynamics models predict frequency, extent, and severity of broad-scale disturbance.

Online http://www.fs.fed.us/rm/pubs/rmrs_gtr194.html

## Bark beetle proceedings

**Order 13**

**Research Area:**

**Proceedings from the third workshop on genetics of bark beetles and associated microorganisms**. Bentz, Barbara; Cognato, Anthony; Raffa, Kenneth, eds. 2007. Proc. RMRS-P-45. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 51 p.

These proceedings provide a synopsis of the third workshop on genetics of bark beetles and association microorganisms, which was held May 20-21, 2006 in Asheville, NC. Twenty-five participants from five countries attended the meeting. The proceedings are structured into four parts: phylogenetics of bark beetles, population genetics of bark beetles, bark beetle gene structure and function, and genetics of symbionts, natural enemies, and hosts. The abstracts give a snapshot of our current understanding of the genetics of bark beetles and associated microorganisms.

Online: http://www.fs.fed.us/rm/pubs/rmrs_p045.html

## Fire Suppression

**Order 14**

**Research Area:**

**Factors affecting fire suppression costs as identified by incident management teams**. Canton-Thompson, Janie; Thompson, Brooke; Gebert, Krista; Calkin, David; Donovan, Geoff; Jones, Greg. 2006. Res. Note RMRS-RN-30. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 10 p.

This study uses qualitative sociological methodology to discover information and insights about the role of Incident Management Teams in wildland fire suppression costs. We interviewed 48 command and general staff members of Incident Management Teams throughout the United States. Interviewees were asked about team structure, functioning, and decision making as a framework for determining their views on issues that drive costs. These findings should be useful in addressing wildfire suppression cost issues in the future.

Online: ttp://www.fs.fed.us/rm/pubs/rmrs_rn030.htm

## Whitebark pine

**Order 15**

**Research Area:**

**Whitebark pine diameter growth response to removal of competition**. Keane, Robert E.; Gray, Kathy L.; Dickinson, Laura J. 2007. Res. Note RMRS-RN-32. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 9 p.

We analyzed stem cross-sections from 48 whitebark pine trees in Montana around which most of the competing vegetation was removed by timber harvest treatments. We compared tree ring growth rates before and after the harvest treatment using intervention analysis to determine 1) the potential of release for this littlestudied tree species and 2) whether the release is related to tree and stand characteristics. We defined release as a statistically significant increase in radial growth after competing trees were removed. Recommendations for appropriate silvicultural cutting are included to aid managers in designing effective restoration treatments.

Online: http://www.fs.fed.us/rm/pubs/rmrs_rn032.html

## Wilderness visitors

**Order 16**

**Research Areas:**

**Changes in the motivations, perceptions, and behaviors of recreation users: Displacement and coping in wilderness.** Hall, Troy E.; Cole, David N. 2007. Res. Pap. RMRS-RP-63. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 37 p.

We describe how wilderness visitors perceive changes in wilderness use, impacts, and management. We examine how visitors have responded to change, both behaviorally and cognitively. The study was based on a sample of visitors to 19 Forest Service wildernesses in Oregon and Washington. Most visitors do not consider changing conditions to be very problematic, probably because their coping mechanisms are successful. This explains lack of support for management actions that restrict access. Very few visitors cannot cope with crowded conditions. Displacement of visitors away from crowded places does not seem prevalent enough for concern about increased crowding and biophysical impact in places in wilderness that are currently lightly used or the validity of on-site visitor surveys.

Online: http://www.fs.fed.us/rm/pubs/rmrs_rp063.html



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## ArcHSI model for elk

**Order 17**

**Research Areas:**

**A different time and place test of ArcHSI: A spatially explicit habitat model for elk in the Black Hills**. Rumble, Mark A.; Benkobi, Lakhdar; Gamo, R. Scott. 2007. Res. Pap. RMRS-RP-64. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 16 p.

We tested predictions of the spatially explicit ArcHSI habitat model for elk. The distribution of elk relative to proximity of forage and cover differed from that predicted. Elk used areas near primary roads similar to that predicted by the model, but elk were farther from secondary roads. Elk used areas categorized as good (> 0.7), fair (> 0.42 to 0.7), and poor (< 0.42) HSI (habitat suitability index) from the model proportional to the distribution of the landscape during summer, but not winter.

Online: http://www.fs.fed.us/rm/pubs/rmrs_rp064.html

# New RMRS Web Publications

## Economic recovery program

**Online only**

**Research Areas:**

**A descriptive analysis of change in eligibility status for the USDA Forest Service Economic Recovery Program**. Gebert, Krista M.; Odell, Susan L. 2007. Res. Pap. RMRS-RP-62WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 32 p.

This report summarizes the results of a 2004 analysis of county-level eligibility for financial and technical assistance through the USDA Forest Service Economic Recovery program and contrasts those results to the initial eligibility analysis performed in 1993. County-level eligibility was based on three criteria: (1) proximity to a National Forest or National Grassland, (2) population, and (3) economic dependency on forest resources. Holding methodology constant, there was a net loss in eligibility of 60 counties, with 413 counties remaining eligible, 237 losing eligibility, and 177 gaining eligibility. On average, dependency on wildland industries decreased regardless of wildland industry sector or eligibility status.

Available only online: http://www.fs.fed.us/rm/pubs/rmrs_rp062.htm

## Soil Quality Index

**Online only**

**Research Areas:**

**Soil vital signs: A new Soil Quality Index (SQI) for assessing forest soil health**. Amacher, Michael C.; O'Neil, Katherine P.; Perry, Charles H. 2007. Res. Pap. RMRS-RP-65WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 12 p.

The Forest Inventory and Analysis (FIA) program measures a number of chemical and physical properties of soils to address specific questions about forest soil quality or health. We developed a new index of forest soil health, the soil quality index (SQI), that integrates 19 measured physical and chemical properties of forest soils into a single number that serves as the soil's "vital sign" of overall soil quality. Regional and soil depth differences in SQI values due to differences in soil properties were observed. The SQI is a new tool for establishing baselines and detecting forest health trends.

Available only online: http://www.fs.fed.us/rm/pubs/rmrs_rp065.html

# Journals and Other Publications

Obtain the following publications through university libraries, the publisher, or other outlets. Forest Service employees may request these items from the National Forest Service Library at FSLibrary-DocsFC@fs.fed.us or telephone: (970) 498-1205.

## Air, water, and aquatic Air, water, and aquatic environments

**Chinook salmon use of spawning patches: Relative roles of habitat quality, size, and connectivity**. Isaak, Daniel J.; Thurow, Russell F.; Rieman, Bruce E.; Dunham, Jason B. 2007. Ecological Applications. 17(2): 352–364. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_isaak_d001.pdf

**Comparison of different stomatal conductance algorithms for ozone flux modelling**. Büker, P.; Emberson, L. D.; Ashmore, M. R.; Cambridge, H. M.; Jacobs, C. M. J.; Massman, W. J.; Müller, J.; Nikolov, N.; Novak, K.; Oksanen, E.; Schaub, M.; de la Torre, D. 2007. Environmental Pollution. 146: 726–735. Online: http://www.treesearch.fs.fed.us/pubs/26826

**Factors controlling $CO_2$ exchange on timescales from hourly to decadal at Harvard Forest**. Urbanski, S.; Barford, C.; Wofsy, S.; Kucharik, C.; Pyle, E.; Budney, J.; McKain, K.; Fitzjarrald, D.; Czikowsky, M.; Munger, J. W. 2007. Journal of Geophysical Research. 112(G2): 10.1029/2006JG000293

**Fine-scale natal homing and localized movement as shaped by sex and spawning habitat in chinook salmon: Insights from spatial autocorrelation analysis of individual genotypes**. Neville, H. M.; Isaak, D. J.; Dunham, J. B.; Thurow, R. F.; Rieman, B. E. 2006. Molecular Ecology. 15: 4589–4602. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_neville_h002.pdf

**Looking at emissions and economics of biomass use**. Ritter, Sharon. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 9-10. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_ritter_s002.pdf

**Microsatellite variation reveals weak genetic structure and retention of genetic variability in threatened Chinook salmon (*Oncorhynchus tshawytscha*) within a Snake River watershed**. Neville, Helen; Isaak, Daniel; Thurow, Russell; Dunahm, Jason; Rieman, Bruce. 2006. Conservation Genetics. 8(1): 133–147. Online: http://www.treesearch.fs.fed.us/pubs/26834

## Fire, fuels, and smoke

**Application of the Nelson model to four timelag fuel classes using Oklahoma field observations: Model evaluation and comparison with National Fire Danger Rating System algorithms**. Carlson, J. D.; Bradshaw, Larry S.; Nelson, Ralph M., Jr.; Bensch, Randall R; Jabrzemski, Rafal. 2007. International Journal of Wildland Fire. 16: 204–216. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_carlson_j001.pdf

**Avifaunal responses to fire in southwestern montane forests along a burn severity gradient**. Kotliar, Natasha B.; Kennedy, Patricia L.; Ferree, Kimberly. 2007. Ecological Applications. 17(2); 491–507. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_kotliar_n001.pdf

**Be careful what you wish for: The legacy of Smokey Bear**. Donovan, Geoffrey H.; Brown, Thomas C. 2007. Frontiers in Ecology and the Environment. 5(2): 73-79. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_donovan_j001.pdf

**CCE fire regimes and their management**. Keane, Robert E.; Key, Carl. In: Prato, Tony; Fagre, Dan, eds. Sustaining Rocky Mountain landscapes: Science, policy, and management for the crown of the continent ecosystem. Washington, DC: Resources for the Future:201–212. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_keane_r001.pdf

**Characterizing stand-replacing harvest and fire disturbance patches in a forested landscape: A case study from Cooney Ridge, Montana**. Hudak, Andrew T.; Morgan, Penelope; Bobbitt, Mike; Lentile, Leigh. 2006. In: Wulder, Michael; Franklin, Steven E., eds. Understanding forest disturbance and spatial pattern: Remote sensing and GIS approaches: 209–231. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_hudak_a002.pdf

**Contingent Pacific-Atlantic Ocean influence on multicentury wildfire synchrony over western North America**. Kitzberger, Thomas; Brown, Peter M.; Heyerdahl, Emily K.; Swetnam, Thomas W.; Veblen, Thomas T. 2007. Proceedings of the National Academy of Sciences of the United States of America. 104(2): 543–548. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_kitzberger_t001.pdf

**Dwarf mistletoe effects on fuel loadings in ponderosa pine forests in northern Arizona**. Hoffman, Chad; Mathiasen, Robert; Sieg, Carolyn Hull. 2007. Canadian Journal of Forest Research. 37: 662–670. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_hoffman_c001.pdf

**Estimating canopy fuel characteristicsa in five conifer stands in the western United States using tree and stand measurements**. Reinhardt, Elizabeth; Scott, Joe; Gray, Kathy; Keane, Robert. 2006. Canadian Journal of Forest Research. 36: 2803–2814. http://www.treesearch.fs.fed.us/pubs/26805

**Factors affecting sustained smouldering in organic soils from pocasin and pond pine woodland wetlands**. Reardon, James; Hungerford, Roger; Ryan, Kevin. 2007. International Journal of Wildland Fire. 16: 107–118. http://www.fs.fed.us/pubs_other/rmrs_2007_reardon_j001.pdf

**Fire danger rating in the United States of America: An evolution since 1916**. Hardy, Colin C.; Hardy, Charles E. 2007. International Journal of Wildland Fire. 16: 217–231. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_hardy_c001.pdf

**Fire history of a western Montana ponderosa pine grassland: A pilot study**. Gayton, Don V.; Weber, Marc H.; Harrington, Mick; Heyerdahl, Emily K.; Sutherland, Elaine K.; Brett, Bob; Hall, Cindy; Hartman, Michael; Peterson, Liesl; Merrel, Carolynne. 2006. In: Speer, James H., ed. Experiential learning and exploratory research: The 13th annual North American dendroecological fieldweek (NADEF). Prof. Paper Ser. No. 23. Terre Haute: Indiana State University, Department of Geography, Geology, and Anthropology: 30–36. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_gayton_d001.pdf

**Local-scale controls of a low-severity fire regime (1750–1950), southern British Columbia, Canada**. Heyerdahl, Emily K.; Lertzman, Ken; Karpuk, Stephen. 2007. Ecoscience. 14(1): 40–47. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_heyerdahl_e001.pdf

**Methodology for assessing departure of current plant communities from historical conditions over large landscapes**. Steele, Brian M.; Reddy, Swarna K.; Keane, Robert E. 2006.



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Ecological Modelling. 199: 53–63. Online: http://www.treesearch.fs.fed.us/pubs/26796

**Modeling fuel treatment costs on Forest Service lands in the Western United States**. Calkin, David; Gebert, Krista. 2006. Western Journal of Applied forestry. 21(4): 217–221. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_calkin_d001.pdf

**The role of wildfire in the establishment and range expansion of nonnative plant species into natural areas**. Johnson, M.; Rew, L. J.; Maxwell, B. D.; Sutherland, S. 2006. Bozeman, MT: Montana State University Center for Invasive Plant Management. 80 p. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_johnson_m001.pdf

**Shared community patterns following experimental fire in a semiarid grassland**. Ford, P. L. 2007. In: Proceedings of the 4th International Wildland Fire conference; May 13–17 2007; Seville, Spain: [unpaginated] 9 pages. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_ford_p001.pdf

**Using models to provide a virtual test of forest treatments**. Sullivan, Janet; Hyde, Kevin. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 4. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_sullivan_j001.pdf

## Forests and woodland ecosystems

**Aspen in the Sierra Nevada: Regional conservation of a continental species**. Rogers, Paul C.; Shepperd, Wayne D.; Bartos, Dale L. 2007. Natural Areas Journal. 27(2): 183–193. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_rogers_p001.pdf

**Assessing host specialization among aecial and telial hosts of the white pine blister rust fungus, *Cronartium ribicola***. Richardson, Bryce A.; Zambino, Paul J.; Klopfenstein, Ned B.; McDonald, Geral I.; Carris, Lori M. 2007. Canadian Journal of Botany. 85: 299–306. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_richardson_b001.pdf

**Benefits of treating old-growth stands**. Harrington, Mick. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 8. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_harrington_m001.pdf

**BEMRP: Conducting research, sharing results**. Jones, Greg. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 3,4. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_jones_g001.pdf

**BLM forest lands report—2006 status and condition**. Bottomley, Tim; Menlove, Jim. 2006. BLM/ST/ST-07/001+5000. Denver, CO: Bureau of Land Management. 111 p. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_bottomley_t001.pdf

**Contribution of actinorhizal shrubs to site fertility in a Northern California mixed pine forest**. Busse, Matt D.; Jurgensen, Martin F.; Page-Dumroese, Deborah S.; Powers, Robert F. 2007. Forest Ecology and Management. 244: 68–75. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_busse_m001.pdf

**Free selection: A silvicultural option**. Graham, Russell T.; Jain, Theresa B.; Sandquist, Jonathan. 2006. In: Powers, Robert F., tech. ed. Restoring fire-adapted ecosystems; proceedings of the 2005 national silviculture workshop; Tahoe City, CA. Gen. Tech. Rep. PSW-GTR-203. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 121–156. Online: http://www.treesearch.fs.fed.us/pubs/25897.

**Microbial community structure and activity in a Colorado Rocky Mountain forest soil scarred by slash pile burning**. Esquilin, Aida E. Jiménez; Stromberger, Mary E.; Massman, William J.; Frank, John M.; Shepperd, Wayne D. 2007. Soil Biology & Biochemistry. 39: 1111–1120. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_esquilin_a001.pdf

**Private industrial foresters and Forest Service research—The relevancy question**. Canton-Thompson, Janie. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 13-14. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_canton_thomas_j001.pdf

**The relation between tree burn severity and forest structure in the Rocky Mountains**. Jain, Theresa B.; Graham, Russell T. 2006. In: Powers, Robert F., tech. ed. Restoring fire-adapted ecosystems; proceedings of the 2005 national silviculture workshop; Tahoe City, CA. Gen. Tech. Rep. PSW-GTR-203. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 213–250. Online: http://www.treesearch.fs.fed.us/pubs/25997.

**Soil productivity and harvest operations**. Page-Dumroese, Deborah. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 11. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_page_dumroese_d001.pdf

**Understanding forest ecology from the landscape to the project level**. McCaughey, Ward. 2007. Eco-Report. Missoula, MT: Bitterroot Ecosystem Management Research Project: 5. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_mccaughey_w001.pdf

## Grasslands, shrublands, and desert ecosystems

**Efficacy of flea beetle control of leafy spurge in Montana and South Dakota**. Butler, Jack L.; Parker, Matthew S.; Murphy, John T. 2006. Rangeland Ecology & Management. 59(5): 453–461. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_butler_j001.pdf

**Potential impact of two *Aphthona* spp. on a native, nontarget *Euphorbia* species**. Wacker, Stefanie D.; Butler, Jack L. 2006. Rangeland Ecology & Management. 59(5): 468–474. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_wacker_s001.pdf

**Soil nitrogen mineralization not affected by grass species traits**. Nosshi, Maged Ikram; Butler, Jack; Trlica, M. J. 2007. Soil Biology & Biochemistry. 39: 1031-1039. Online: http://www.fs.fed.us/pubs_other/rmrs_2006_nosshi_m001.pdf

**What makes Great Basin sagebrush ecosystems invasible by *Bromus tectorum*?** Chambers, Jeanne C.; Roundy, Bruce A.; Blank, Robert R.; Meyer, Susan E.; Whittaker, A. 2007. Ecological Monographs. 77(1): 117–145. Online: http://www.fs.fed.us/pubs_other/rmrs_2007_chambers_j001.pdf

## Social, economic, and decision sciences

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# Fire Effects Information Database

The Fire Effects Information Database is available online through the U.S. Forest Service web site: http://www.fs.fed.us/database/feis/. FEIS provides up-to-date information about fire effects on plants and animals. It was developed at the United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory in Missoula, Montana. Species recently added include:

| Species name | Common name |
|---|---|
| *Acer grandidentatum* | bigtooth maple, canyon maple, western sugar maple |
| *Artemisia californica* | California sagebrush, coastal sagebrush, California sagewort, California mugwort |
| *Artemisia norvegica* | boreal sagebrush, arctic wormwood, boreal sagewort, spruce wormwood |
| *Arundinaria gigantea* | cane, giant cane, switch cane |
| *Bromus carinatus* | California brome, mountain brome, mountain bromegrass |
| *Cercis orbiculata* | California redbud, western redbud, Arizona redbud, Judas tree |
| *Cercocarpus montanus* | true mountain-mahogany, alderleaf mountain-mahogany, Arizona mountain-mahogany, birchleaf mountain-mahogany, California mountain-mahogany, hairy mountain-mahogany, island mountain-mahogany, Klamath mountain-mahogany, shaggy mountain-mahogany, silverleaf mountain-mahogany, smooth mountain-mahogany, western mountain-mahogany |
| *Eurybia macrophylla* | bigleaf aster, large-leaved aster, big-leaved aster |
| *Eurybia horrida* | horrid herrickia, spiny aster |
| *Fragaria vesca* | woods strawberry, woodland strawberry, wood strawberry, starvling strawberry, wild strawberry |
| *Goodyera oblongifolia* | western rattlesnake plantain, rattlesnake plantain |
| *Gynmorhinus cyanocephalus* | pinyon jay |
| *Juniperus flaccida* | drooping juniper, Mexican drooping juniper, weeping juniper, weeping cedar, drooping cedar |
| *Juniperus horizontalis* | creeping juniper, creeping cedar, creeping savin |
| *Juniperus pinchotii* | Pinchot juniper, Pinchot's juniper, redberry juniper, red-berry juniper, Texas juniper, Christmas berry juniper |
| *Limnothlypis swainsonii* | Swainson's warbler |
| *Linum lewisii* | Lewis flax, blue flax, Lewis' blue flax, western blue flax, prairie flax |
| *Lupinus latifolius* | broadleaf lupine, broad-leaved lupine |
| *Lupinus perennis* | wild lupine, blue lupine, sundial lupine, perennial lupine |
| *Lycaeides melissa samuelis* | Karner blue butterfly |
| *Melanerpes erythrocephalus* | red-headed woodpecker |
| *Mertensia paniculata* | tall bluebells, tall mertensia, panicled bluebells, lungwort |
| *Myrica pensylvanica* | northern bayberry, bayberry, candleberry |
| *Nolina microcarpa* | sachuista, beargrass, palmilla, smallseed sacahuista |
| *Patagioenas fasciata* | band-tailed pigeon |
| *Pediocactus knowltonii* | Knowlton's miniature cactus, Knowlton's minute cactus |
| *Perisoreus canadensis* | gray jay, grey jay, Canada jay, whiskey Jack, camp robber |
| *Phlox hoodii* | Hood's phlox, carpet phlox |
| *Quercus garryana* | Oregon white oak, Garry oak, Oregon oak |
| *Ribes triste* | swamp currant, red currant, wild red currant, northern red currant, American red currant |
| *Rosa woodsii* | Wood's rose, mountain rose, interior rose, Fendler rose, wild rose, Tehachapi rose |
| *Sphaeralcea cocinea* | scarlet globemallow, red false globemallow, copper mallow |
| *Strix nebulosa* | great gray owl, great grey owl, great cinereous owl, Lapland owl, Siberian owl, sooty owl |
| *Vulpia microstachys* | small sixweeks grass, small six-weeks grass, small fescue |
| *Vulpia myuros* | rattail sixweeks grass, rat-tail six-weeks grass, rattail grass, rattail fescue, Zorro fescue, foxtail fescue (plants describes as *Festuca megalura*) |
| *Yucca brevifolia* | Joshua tree, yucca palm |
| *Yucca schidigera* | Mojave yucca, Mohave yucca, Spanish dagger |
| *Zigadenus venenosus* | meadow deathcamas, grassy deathcamas, deathcamas, death camas, hog potatoes |



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# Science Program Areas

## Air, Water, and Aquatics Science Program

Air quality, water availability, water quality, and aquatic habitats are critical issues within the rapidly changing Western United States. Air, water, and aquatic resources are essential to society, as a life support and as an economic mainstay for individuals, communities, local and state governments. Forest and rangeland land management, coupled with human expansion has a significant influence on the quality and quantity of these resources. A long history of overgrazing by livestock, timber harvest, fire suppression, mining operations, recreational activities, road construction in valley and canyon bottoms and hill slopes, and dams and water diversions is impacting entire watersheds. Increasing dependence upon watersheds for off-site domestic water supplies, irrigation, and recreation has added complexity to the challenges faced by watershed managers. Natural disturbances, such as climate change and uncharacteristic fires and weather patterns are rapidly changing known patterns outdating current air, water, and aquatic management understanding and monitoring. Research is needed to understand natural processes, and how human management and other interventions impact these critical resources.

The *Air, Water, and Aquatic Science Program* is committed to the development of knowledge and science applications related to air and water quality, as well as the habitat quality, distribution, diversity, and persistence of fish and other aquatic species.

The RMRS *Air, Water, and Aquatic Science Program* objectives are aligned with our National Forest Strategic Plan and National Research and Development Strategic Program Areas: **(1) Ecosystem Processes—**Providing basic and applied science to understand how ecosystem processes and management actions influence forest and rangeland air quality, water quality and quantity, and aquatic habitats. (2) **Air and fire Interactions—**Providing basic and applied science to understand wildland fire behavior, danger, smoke and weather to reduce risk to lives, property, and natural resources. (3) **Climate Variability and Extreme Events—**Providing science to understand how air and water pollution, climate variability and change, and chronic and extreme events impact aquatic, forest and rangeland sustainability and the benefits they provide to society. (4) **Tools Development—**Developing and providing the tools necessary to manage forest and rangelands in ways to protect watersheds, minimize negative impacts of wildland fire on air quality, protect people, resources and structures from fire, improve watershed habitat quality and protect biodiversity.

## Aldo Leopold Wilderness Research Institute

The *Aldo Leopold Wilderness Research Institute* serves as a model for interdisciplinary, cross-programmatic science and application. A small core of scientists and research application specialists familiar with wilderness law, policy, and management provide a nucleus for working with scientists from all program areas to help assure that the science necessary for the understanding and stewardship of designated wilderness and similarly managed wild ecosystems is developed, delivered and applied to those responsible for managing such lands. Developed as an interagency program (support is provided by the FS, BLM, FWS, NPS and USGS) with national scope, the Leopold Institute's recent Program Review identified the following five Problems upon which it will focus it's initial efforts:

- Recreation impacts and management.
- Relationships between people and public lands.
- Wilderness fire stewardship and management, including wildland fire use.
- Wilderness in the context of larger ecological and social systems, including issues related to wildlife, water, and invasive species that do not recognize administrative boundaries.
- Science delivery and application.

In the new RMRS structure, the Leopold Institute will serve as a cross-cutting science program that provides a focal point for partnerships and collaborations between scientists and managers for development, discussion and debate about information and ideas related to the natural resources, values and benefits of wild lands as well as the opportunities and challenges of wilderness stewardship. In addition to continuing its long history of conducting, supporting, and facilitating scientifically rigorous research, Institute staff will work with the seven primary RMRS Science Programs to assure that scientists from multiple disciplines collaborate in ways that maximizes the utility of the research conducted to better understand and manage wild ecosystems. We anticipate that new liaisons will be developed with scientists in other Programs through cross-programmatic science teams and other collaborative arrangements. These will bring new expertise to the wilderness arena as well as facilitate the application of knowledge and lessons learned in wilderness to broader landscapes. We will work cooperatively with Station and R&D leadership to develop the capacity to serve as a clearing house for tracking research relevant to wilderness that is conducted throughout the Station as well as the rest of the agency. The Institute's established Research Application Program will also work to establish effective working arrangements with other science Programs.



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## Fire, Fuels, and Smoke Science Program

The *Fire, Fuels, and Smoke Science Program* of the Rocky Mountain Research Station has a national charter to conduct fundamental research relating to wildland fire processes and effects, and to develop associated knowledge tools and applications for both scientists and managers. Our mission is to improve the safety and effectiveness of fire management through the creation and dissemination of basic fire science knowledge. To accomplish this mission, we investigate the impacts of fires on the environment by means of fundamental and applied research for understanding and predicting fire behavior, its effects on ecosystems, and its emissions into the atmosphere. Specifically, the scope of work addresses five components: (1) precursors to fire, (2) combustion and fire behavior processes, (3) immediate (first-order) fire effects, (4) longer term (second-order) fire effects, and, (5) the use or application of fire. Fire precursors include landscape dynamics and the processes that contribute to pre-fire conditions, such as fuel dynamics (vegetation phenology, accumulation and decay of fuelbed components). Combustion processes and fire behavior research includes the study and prediction of the physical processes of fire activity, such as fire spread rate, intensity, heating thresholds, energy transfer mechanisms, smoke emissions source strength, and fire-atmosphere interactions. First-order fire effects include soil heating, bole and crown scorch, fuel consumption, and smoke dispersion. Second-order effects include vegetation response (fire-caused mortality and subsequent succession), combustion-related carbon and nutrient cycling, impacts of fire on regional air quality, and long-term ecosystem dynamics. Knowledge of fire behavior processes, smoke characteristics, fuels, and fire ecology are integrated into fire management decision support systems for fire management planning, wildland fire suppression, fuel treatment, wildland fire use and prescribed fire applications, and ecosystem restoration projects.

## Forests and Woodlands Ecosystems Research Program

The *Forests and Woodlands Ecosystems Research Program* of the Rocky Mountain Research Station acquires, develops, and delivers the scientific knowledge basis for natural resource management activities for sustaining and restoring forests and woodlands landscape health, biodiversity, productivity, and ecosystem processes in the Intermountain West, the Rocky Mountains, and the Southwest. The scope of the program includes subalpine, aspen, mixed-conifer, and ponderosa pine forests, and pinyon-juniper and oak woodlands as well as ecotones with shrublands, grasslands, and deserts. Increasingly these forests and woodlands are being impacted by large scale urbanization and human developments, uncharacteristically large and severe wildfires, insect and disease outbreaks, exotic species invasions, and drought, and interactions of multiple stressors at local, landscape, and regional scales. These forests and woodlands are the critical source of water, natural resources, esthetic and recreation amenities, and wildlife habitat in the West. The research program addresses the basic ecology of forest and woodland vegetation and soils and related ecosystem biota and processes as the basis for understanding the function, composition, and structure of these complex ecosystems. The program further develops vegetation and fuels management and restoration strategies as well as quantitative tools to guide management and restoration planning and treatment implementation. The program provides understanding of the complex interactions of management treatments and other ecosystem disturbance processes temporally and spatially. Disturbance mechanisms include resource management and use; wildland fire; complexes of native bark beetles and defoliating insects and disease outbreaks; invasive plants, insects, and diseases; drought; and climate change. Researchers in the program are located at laboratories in Idaho, Montana, Utah, Colorado, and Arizona, and collaborate with scientists in other agencies, academic institutions, public organizations, and land and resource managers nationally, and internationally and throughout the Station territory.



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## Grassland, Shrubland and Desert Ecosystem Program

The *Grassland, Shrubland and Desert Ecosystem Research Program* addresses the biology, use, management, and restoration of vast tracts of land including National Forest System and other public lands that are important for human well-being and landscape health, biodiversity, productivity, watersheds, and sustainability. Ecosystems dominated by grasses and shrubs occupy 75 percent (353 million ha) of the potenial natural vegetation of the 17 western conterminous United States. These ecosystems including grasslands, shrublands, shrub steppe, and pinyon-juniper woodlands (for the most part inseperately bound with the shrublands upon which they are dependant) can be very large, e.g., sagebrush, short grass praire, creosote bush, salt desert shrub. However, topographic diversity coupled with variable precipitation patterns, agricultural development, and riparian corridors impose mosaics and discontinuities. Ecotones and edge effects make for diverse landscapes including some that are not sustainable in their present condition. Disruptions by large-scale clearing for agriculture, water diversions, the introduction of an extensive domestic livestock grazing industry, changes in the native fauna, the advent of alien weeds, altered fire regimes, and increases in human-caused insect and disease epidemics have contributed to produced areas that are in unsuitable condition. Research is needed to understand and manage these plant communities and their associated biota. Scientists of the research program with interdisciplinary skills are located in laboratories in South Dakota, New Mexico, Idaho, Montana, Utah, and Nevada. They and cooperating scientists and land managers are working on solving ecological problems, identifying and developing native plants for restoration, controlling and managing invasive weeds, and improving wildlife habitats and rangelands.

## Inventory, Monitoring and Analysis Science Program

**Mission:** The Rocky Mountain Research Station Inventory, Monitoring, and Analysis (IMA) Science Program provides the resource data, analysis, and tools needed to effectively identify current status and trends, management options and impacts, and threats and impacts of fire, insects, disease, and other natural processes, enhancing use and value of our Nation's forest, range and grassland natural resources.

Functions of the IMA Program include:

***Conducting Resource Inventory***—Provide data, reports, maps, and consultation services to forest managers, land owners, policy makers, researchers, analysts, and other interest groups so they can use scientifically sound information to conduct analyses in a timely manner. This includes the Station's Interior West Forest Inventory and Analysis Program.

***Conducting Periodic Resource Assessments***—Provide resource monitoring and assessment services to international, national, state, and local policy makers, land managers, investors, and municipalities so they can make informed decisions based on scientifically credible analyses. This includes the Station's Resource Planning Act (RPA) efforts, either within the Program or as part of a cross-Program integrated effort.

***Conducting Quantitative Analysis and Techniques***—Provide techniques, tools, and analyses services to public and private land management organizations, consultants, industry, and interest groups so they can make inventory and monitoring more effective and efficient and so they can identify risks, trends, and emerging issues to make sound decisions and land management plans. This includes both internal Program inventory and monitoring analysis and techniques as well as strong linkages to other Program quantitative analysis and techniques such as wildlife habitat, fire conditions and risk, and climate change.

**Vision**: Resource data are complete across the landscape for cross-boundary assessments, of known quality for appropriate application, scalable to the application of interest, and timely to current situations and impacts. Appropriate tools are available and in use, improvement is continuous, and resource data are updated annually.



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## Social, Economics, and Decision Sciences Program

The *Human Uses, Economics, and Decision Sciences Program* of the Rocky Mountain Research Station provides social and economic science-based innovation to human societies as they develop a sustainable relationship with their environment. Major issues confronting societies across the globe such as global climate change, energy, fire, water, and ecosystem services all have important social-economic dimensions that will be explored and addressed by this program. The national RPA scientists are in this program. RPA will be expanded and work closely with the *Inventory, Monitoring, and Analysis Program* to provide a robust, Regional (interior west), dynamic knowledge base. Expertise residing in the program includes market and non-market economics; collaborative planning and community involvement; decision science and operations research; and risk management and organizational development. This program will work closely with the *Fire, Fuels, and Smoke Science Program* and the *Wildland Fire Management RD&A* to improve firefighter and public safety, reduce large fire costs, expand the wildland fire use program, and expand the treatment of hazardous fuels for watershed restoration that is strategic, cost-effective, and socially acceptable.

## Wildlife and Terrestrial Habitats Program

The *Wildlife and Terrestrial Habitats Program* aligns well with the national Wildlife and Fish SPA activities. Progress towards these activities represents contributions from all station science programs, and not just Wildlife and Terrestrial Habitats. Brief descriptions of the program by SPA activities are provided below.

***Sustaining Species/Ecosystems of Concern*** — More ecosystems occur within RMRS boundaries than any other station, spanning prairie, temperate and tropical steppe, desert, coniferous and riparian forests, and tundra. This diversity of ecosystems translates into a diversity of plants and animals with the RMRS region supporting >16,800 plants and animals. More than 3,800 species are of conservation concern, and 217 are formally listed as threatened or endangered. Because more than 90 percent of the appeals and litigation of land management decisions are based on wildlife and fish concerns, studies that provide credible scientific information are critical for meeting legal obligations and sustaining threatened, endangered and sensitive species and their associated ecosystems. Multi-scale studies identify a variety of factors that affect the persistence of species, communities, and ecosystems of concern, such as northern goshawks in southwestern ponderosa pine forests and forest carnivores in the Northern Rockies. The context for most studies includes ecological interactions within and between plant, aquatic, and terrestrial animal communities in a wide variety of ecosystems throughout the Intermountain West and beyond.

***Understand Public Use Effects***—Research informs federal, state, tribal, and local resource agencies on interactions between people and fish/wildlife. It provides better understanding of public-use effects such that they can be mitigated by appropriate management actions. Although much of the research focuses on recreation effects (OHVs, hikers, birdwatchers, heli-skiing), similar lines of research evaluate effects of transmission corridors and indirect effects of noise resulting from land-management activities. Numerous studies are underway to elucidate social and economic values associated with consumptive and non-consumptive uses of fish/wildlife. Predictive habitat models provide a range of management alternatives for simultaneously enhancing commodity and non-commodity uses of fish/wildlife.

***Manage for Terrestrial and Aquatic Habitats***—Most of the remaining habitats for many species of concern are now found on National Forests and Grasslands. RMRS scientists answer questions about the amount, kind, distribution, and connectivity of habitat critical to the persistence and abundance of these species. These researchers also devise robust techniques for monitoring changes in species and habitats and for recognizing habitats most sensitive to management or essential to species persistence. Scientists also investigate the spatial and temporal aspects of processes that create and maintain habitats crucial for sustaining biodiversity, including the role of fire.

***Evaluate Outcomes of Land/Water Uses and Natural Disturbances***—A wide array of anthropogenic and natural disturbances affects our grasslands, forests, and waterways. Natural and prescribed fires, silvicultural prescriptions, livestock grazing, spread and control of invasive species, drought, global climate change, insect and disease outbreaks and fragmentation all affect, and potentially threaten wildlife habitats. Researchers are determining immediate, long-term, and cumulative effects of disturbances on species of concern and interest in the Intermountain West.



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